# DSN Tracking System: Conversion to High-Speed Radio Metric Data

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*At the present time, radio metric data are transmitted from the Deep Space Stations via the teletype mode. To meet future requirements, and to update the transmission mode, the operational concept is scheduled to be changed to utilize the high-speed data transmission facilities. This article outlines the implementation schedule and the testing requirements to provide this new capability.*

## I. Introduction

The transmission of radio metric data from the Deep Space Stations (DSSs) will be changed from the teletype mode to high-speed mode for first use in support of the Mariner Venus/Mercury 1973 Project to meet the requirement of providing 10/s doppler sampling at all stations and dual S/X-band doppler counting at DSS 14. This change involves certain hardware changes, as well as the supporting software packages. The radio metric data will be formatted for high-speed data (HSD) transmission by the station Digital Instrumentation Subsystem (DIS) equipment and transmitted via normal Ground Communications Facility (GCF) HSD circuits.

## II. Station Configuration

The present Deep Space Station interface between the Tracking Data Handling (TDH) equipment and the DIS does not provide the required high-rate sampling, the additional doppler count, or the complete status and configuration information. A change to this interface is the first requirement in reconfiguring the stations for the new mode of operation. The necessary Equipment Change Orders (ECOs) have been issued and approved for installation. The implementation of the ECOs will be coordinated with other station changes for the 26-m DSSs and will be included as initial configuration for the new 64-m stations in Australia and Spain (DSS 43 and DSS 63).

## III. Configuration Change Schedule

The present schedule for the TDH modification for the station DIS interface calls for the initial implementation at DSS 14. This installation started in the latter part of November 1972 with a tentative completion date of mid-December. Testing will then be conducted at the station to ensure satisfactory operation and make-up of the installation instruction kit. When DSS 14 has demonstrated acceptable operational capability, the instruction kits will

be shipped to the other stations. It is anticipated that the shipment will be made during mid-January 1973, with completion of the installation at all stations by the first of March 1973.

## IV. High-Speed Data Interface Testing

Interim testing of the software and hardware will commence shortly after the completion of the installation at DSS 14. The interim testing will be used to allow the programmers for the DSS and the Mission Control and Computing Center (MCCC) to debug the software packages being implemented. This testing is scheduled for the period of December 1972 through mid-February 1973. The initial testing will be limited as to decoding the data block at the MCCC, as the software for this function will not be integrated into the operational software before February 1973. Station hardware and software integration, as well as Deep Space Station testing and acceptance, will take place between the first of April and mid-June 1973. This activity will allow limited interface testing of the capability on a non-interference basis.

## V. DSN Combined System Testing

The DSN Combined System Testing for operational acceptance will be initiated in mid-June 1973 and be completed, with the capability turned over to operations, by October 1, 1973. Level 1 and Level 2 testing will be conducted as the stations become available and are accepted. A Level 1 test will consist of one DSS, configured as for an actual tracking period, acquiring a spacecraft in one- or three-way mode, generation of radio metric data, transmitting the radio metric data to the MCCC and Network Control System (NCS) via GCF high-speed data line, and the processing of the data by MCCC and NCS, all in real time. Various sample rates will be used, from 10/s to 1/60 s. Predicts will be generated by the MCCC and transmitted to the station via High-Speed Data Line (HSDL) and used in the Antenna Pointing System (APS) to drive the antenna. Simultaneous telemetry and monitor and operations control data will be transmitted via the HSDL to present a loading factor comparable to a cruise mode condition. When conditions allow, the station will operate in a two-way mode with the spacecraft and command traffic introduced into the system. All processing capabilities will be exercised, including writing of a project tape by MCCC to be checked by project programs. Numerous dumps and displays will be checked to ensure that data and parameters are correct according to inputs.

A Level 2 test will consist essentially of a Level 1 test but will be conducted with two or more DSSs simultaneously. If a spacecraft is not in view for any of the stations, simulated radio metric data will be used. The acceptability of the DSS capability will be based on the acceptance criteria established for the function.

## VI. High-Speed Radio Metric Data

The primary objective of the high-speed data mode of operation is to provide 10/s, 1/s, and other high-rate sampling for operations in real time. The current teletype mode for 1/s rate rapidly becomes backlogged and, for high activity phases of operation, limits real-time evaluation and use of data. The HSD mode will also remove the last teletype mode from the DSN operational network. Telemetry, command, and monitor have been operating in this mode for some time, and with the inclusion of radio metric data only administrative traffic will continue to be handled by teletype. The teletype capability will be maintained as backup for radio metric data until January 1, 1974.

The data sample rates included in the high-speed data mode will be 10/s and 1/s and 1 per 2, 5, 6, 10, 20, 30, and 60 s. Twenty samples of data will be included in one HSD block for the 10/s sample rate and four samples for other sample rates. The blocks will be transmitted after a HSD block is complete, according to sample rate, so that the transmission rate to line will be dependent on the sampling rate. X-band and S-band data will be included for both range and doppler data. Necessary configuration information is included to provide complete evaluation of each HSD block.